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Highly interactive multimedia application design

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HIGHLY INTERACTIVE MULTIMEDIA APPLICATION DESIGN

by
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Dedicated to my loving family and parents.

foreword

- introduction
- about my thesis
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Interactive multimedia is not a term for a few people any more in daily life even though it has a relatively short history. However, it is not easy to define precisely what interactive multimedia is and what it should be. In the foggy confusion about multiple media, defining what interactive multimedia is more difficult because making the word, interactive, clear is as difficult as "multimedia". As the English consultant Tony Feldman mentioned, if we assume that "multimedia is the seamless integration of text, sound, images of all kinds and control software within a single digital information environment," what is the definition of "interactive" ? In spite of all of the obvious power, efficiency, and flexibility of digital media, it is a curiously disembodied form of communication. Unlike older media such as print or even videotape, digital information has no required physical form, and one of digital media's main advantages is precisely that it can change form and arrangement in response to the user's interactions.

Today, rapid progress in computer technology is bringing enormous new interactions between a machine and a human, these include speech understanding, eye tracking, head tracking, and gesture recognition, which are considered more human than keyboards and mice. Yet, it would take quite a long time before they appear in the market. In fact, after the success of Apple and Macintosh in the mass market, GUI (graphical user interface) became a mainstream model in the UI (user interface) world. Despite some limits that mice have, the point-and-click model is well established as a standard for interactive multimedia.

As GUI dominates, transferring information through screens is the main route to communicate between humans and computers. As a matter of fact, communication between users and computers occurs when users face screens. Thus, a successful communication needs a successful interface design, which contains successful interactions and good screen design. However, interactivity is not about clicking buttons and being shown material, whether it is graphic, text, sound or video, but is a way of involving the audience or user to a high degree to achieve successful communication. How can users be involved to an interactive multimedia application? The only way that makes it possible is to keep continuous intensity of interactions between users and computers. If so, how can we keep continuous intensity of interactions? It is not that easy to answer. The answer should be provided by cooperative efforts of experts from several fields, such as interface designers, psychologists, human factors experts, and computer scientists.

About my thesis

The purpose of this thesis is to develop an interactive multimedia application which offers highly intensive interactions to achieve active engagement from users, like games do. In addition, the project is basically intended not to make a commercial-looking application, but to explore new possibilities of user-computer interactions based on the GUI. To accomplish the goal, this thesis requires not only technical knowledge and skills but also deep understanding about human factors and computer-human interaction. Macromedia Director and Alias/Wavefront will be the primary software to create a highly interactive appli-

cation with three-dimensional animated interfaces. Also, Adobe After Effects will be utilized in many parts to create two- dimensional motion graphics and Quicktime movies.

About this paper

Basically, my thesis project consists of two parts, writing a paper and making a prototype. This paper was intended to visualize my thesis in a literal form. I did my best to make the paper be complete by itself. However, the two parts are basically linked with a complimentary relation to each other. Also, there would be some details which can not be described in a literal way. I recommend that you explore the other part of my thesis, the prototype.

research: *some issues for highly interactive interface.*

- **intensity of interaction**
- **consistency**
- **simplicity of navigation**

As I mentioned before, the primary goal of my thesis project is to develop a highly interactive multimedia application based on the GUI. First, in order to achieve the goal I had to define the meaning of "highly interactive". Then, I had to look closely into how it is related with graphical user interfaces.

Those are some issues that I considered in the process of developing my thesis prototype. However, I do not think that those rules can be applied to all multimedia applications perfectly at any time. There are numerous kinds of multimedia applications, users, and information. Thus, the process of developing an interactive multimedia application should be a process of compromising things that consists of applications.

1. Intensity of interactions

If we consider that the goal of multimedia is effective and expressive communication between users and computers, what can make that communication possible? One of the most important things that can lead the communication to a success is intensive interactions between humans and computers. What does "intensive interactions" mean? It means continuous, immediate, and interesting interactions through multiple media and modalities. Higher intensity of interactions keeps users in continuous communication with computers or applications with a lot of fun. In other words, interactions should be a way of involving the audience or the users to a high degree. However, effort spent on the user interface is valuable when it adds value to the content, but annoying when it becomes the focus of the application.

1.1 Direct manipulation

The types of human computer interaction can be categorized primarily into five types: menu selection, form filling, command language, natural language, and direct manipulation. [Shneiderman, 1993] They are utilized by character of tasks and expected users. Therefore, blending several interaction styles may be appropriate when the required tasks and users are diverse. Each style has its own advantages and disadvantages. However, in terms of intensity of interactions, direct manipulation is most powerful to develop highly interactive multimedia applications.

With the introduction of direct manipulation, GUI design has grown rapidly. The concept of direct manipulation offers bidirectional communication between humans and computers through the physical manipulation of icons and visual elements. With the evolution of graphical technologies, interactive graphical interfaces are replacing physical control panels across all forms of tools machines, appliances, and other devices. [Meera M. Blattner and Roger B. Dannenberg, 1995]

The success of direct-manipulation interfaces is indicative of the power of using computers in a more visual or graphic manner. A picture is often cited to be worth a thousand words and, for some tasks, it is clear that a visual presentation is dramatically easier to use than textual description or a spoken report. The direct manipulation has several advantages. It presents task concepts visually. It is easy to learn and easy to retain. It also encourages exploration and permits high subjective satisfaction.

In direct manipulation, the elements on the screen behave as if they are the objects that they represent. According to Brenda Laurell "The distinguishing features of direct manipulation are claimed to be continuous representation of the objects of interest, physical actions instead of complicated syntax, and rapid, incremental, reversible operations immediate visual feed back." [Laurel, 1995 a] The following is advantages of direct manipulation style.

Advantages

-presents task concepts visually

-is easy to learn

-is easy to retain

-allows errors to be avoided

-encourages exploration

-permits high subjective satisfaction.

1.2 Animation

Animation can be primarily categorized into two forms, best described as static and dynamic. A static animation appearance is unchanged over a period of time and changes only at the moment a system event occurs. A dynamic animation movement is independent of a system event, changing appearance to represent functions, processes, states, state transitions. Animation can be used to provide feedback which can help us answer the questions: "How did I get there?", "Where I am?", and "Where am I going?". and to create visual interest.

We shall describe eight uses of animation - animation as:

- Identification:	What is this?
- transition:	From where have I come, to where have I gone?
- choice:	What can I do now?
- demonstration:	What can I do with this?
- feedback:	What is happening?
- history:	What have I done?
- guidance:	What should I do now?

[Laurel, 1995 b]

1.3 Synchronization -- audio to visual information

It is critical that multimedia events should be activated and inactivated on schedule: " The required accuracy of the activation events depends on the type of information being synchronized. Synchronizing sound to sound requires most precision. Deviations of more than 3 ms are perceptible in audio mixing. Deviation of more than approximately 33 ms are perceptible in mixing visual information. Synchronizing audio to visual information is in the same condition as synchronizing visuals to visuals." [Blattner and Dannenberg, 1995 b] Because a computer is interrupt-driven, devices literally have to interrupt the CPU to get it to drop its present task and devote time to the request for service until something more important comes along and demands attention. Programmers are very clever at developing contention schemes that make the CPU look like it's devoting attention to several events at the same time, but the inevitable result is that the computer slows down and loses the control of synchronizing when things get busy as the CPU rushes around trying to service all the requests. Even if it works well on your computer, you never assume that it would work on another computer which may have different configuration. This offers a major challenge to the distribution of multimedia programs. [multimedia creation, 1993]

In particular, synchronizing audio to visual information is more critical when it involves animations, movies, transitions, and feedbacks. The failures of synchronizing damages the reality or illusion which an application has built and

which is a critical part of active engagement of users. Even worse, the rhythm of communication between users and computers will be disturbed. In essence, no audio is better than unsynchronized audio to visuals.

1.4 3D metaphors

A recent trend to improve the adaptiveness of users' mental models of systems in that of incorporating so-called metaphors within interface design. If an interface display looks and works like a filing cabinet, for example, the user will not need to learn much to know how to file and retrieve documents. As a result, the need for learning is minimized through predictability in terms of how real world objects behave. The closer a representation of a metaphor is to reality, the more effective it is to build a user's mental model of a system.

Basically, the spatial relationships of three-dimensional objects is fundamental to our vision and understanding of the world. Users assume that interface elements rendered as three-dimensional objects will function much like their real-world counterparts. For example, control panels, buttons, and other interface objects meant to be "manipulated" or clicked on are often rendered as if they existed as real three-dimensional objects. Thus, three-dimensional spatial representations compliment and reinforce interface metaphors. It is a comprehensible trend that the three-dimensional metaphors dominate in GUI, after the field of three-dimensional computer graphics has vividly demonstrated the power of three-dimensional modeling, rendering, display and interaction. This concept was directly taken over by virtual reality interfaces.

The ability to represent interactive three-dimensional objects is one of the most unique aspects of interactive multimedia, offering opportunities for multimedia designers to move beyond merely converting existing print or audiovisual content into digital multimedia.

2. Consistency

We, users as well as interface designers, have a tendency to perceive smooth, continuous patterns rather than discontinuous ones. Users are eager for continuity, and if a designer does not provide it, they attempt to improve it on their own. Part of the covenant of trust is that you design and develop the medium, presentation, organization, and content of your information in such a way as to take advantage of continuity. The continuity must be intuitive and transparent to users. Users should always see the flowing sine wave and never even be aware of the possibility of disjointed, alternating semicircles. [Coe, 1996] People perceive a system as a single entity. To them, it should look, act, and feel similarly throughout.

Consistency in interfaces primarily refers to common action sequences, terms, units, function, layouts, color, typography, and so on within a application or system. Consistency also enhances a user's expectation of what would happen as a sequence of their actions. [Laurel, 1995 c] Consistent formats help users to locate necessary information, focus users' attention on relevant material and reduce users' frustration by offering transparent predictability. [Shneiderman, 1993 b] The predictability makes interactions more natural and continuous. Because short-term memory and working memory are highly volatile, discontinuity can cause loss of memory, and delay can require that the memory be refreshed.

Inconsistency needs more learning requirements and more cognition loading time. Excess learning requirements become a barrier to their achieving and maintaining high performance and can ultimately influence user acceptance of the system. One study reported that user thinking time nearly doubled when the position of visual elements, such as titles and field captions, was varied on a series of menu screens. [Galitz, 1996 a]

Result of inconsistency in interfaces

- more specialization by system users.
- greater demand for higher skills.
- more preparation time and production time.
  more time to find information in documents.
- more things to do wrong.
- more help system.
- more cognition loading time
  [Galitz, 1996 b]

The followings are some aspects that I considered to achieve successful consistency in developing my thesis prototype that makes interactions predictable and transparent.

2.1 In layouts

In the process of screen design, some critical things that should be considered are locations, shapes, and sizes of visual elements. Especially, the consistency

in location is most critical in layouts because people do tend to have better memories for locations of things. If an inconsistency will benefit the user, such as calling attention to something extremely critical, consider deviating from consistency. However, casual inconsistency must be avoided. Without a strong motivating reason, these constant changes cause the user to work harder to understand the essential message of the screen.

visual elements that need consistency in size and location

- windows
- buttons
- icons and logos
- text
- background
- labels
- fonts and typography

2.2 In feedback

There are three categories of feedback: auditory, visual, tactile. Interface feedback is the process of managing the timeliness and manner of the computer's response to a user's actions. Feedback is, also, an indication of what we have done with an object. Positive feedback indicates that we have successfully used an object. Negative feed back indicates that we have not successfully used an object. In communication, feedback means any indication that the receiver has obtained knowledge from the giver. Also, feedback shapes human performance.

Efficient learning of the mental model will not occur unless feedback is provided concerning the correctness of all actions taken. A system should acknowledge all actions by immediate execution, change in state or value, correction message, confirmation message, and in-progress message. Feedback is a conversational interaction which should be consistent as well as immediate and unambiguous, in the form of visual or auditory signals that the computer has received input from the user and is acting upon that stimulus. Human-computer interaction cannot exist without immediate, clear feedbacks because feedbacks are a route of interactions as well as interactions themselves. Thus, inconsistency in feedback means confusion, frustration, and anxiety to users because of the fact that inconsistency in feedback means disability of conversation between a user and a system.

two aspects of consistency in feedback.

- consistency in channels --- visual, auditory, or tactile
- consistency in reactions--- highlight, blinking, color change, size change, animation, message box, narration, sound effect, and so on.

2.3 in function of elements

There are two aspects of consistency in terms of function of elements: internal consistency and external consistency. The simple principle of internal consistency in function is that the GUI should depend on the same conventions and rules for all elements. If one function, for example, has been assigned to a given visual element, do not reassign it later to a different element. The lack of external consistency can cause confusion for users moving across applications.

[Baecker, Gradin, Buxton, and Greenburg,1995]

Imagine what would happen, for example, if each measure uses different measuring system. Consistency in function can make learning of new applications simple and reduce the likelihood of negative transfer, which can happen when different programs require different user responses to initiate the same function.

2.4 Color use

Color adds new possibilities to screen usability after color monitors became available. Color draws attention because it attracts a person's eye.If used properly, it can enhance the logical organization of information, facilitate the discrimination of screen components, accentuate differences among elements, create ambience in an application, and make the display more interesting.
[Galitz, 1996 b]

Consistency in color usage should exist within a screen, a set of screens, and a system. A person can sense the relation of color in space and over time.
An identical background color in windows on different screens, for example, will be seen as related. Also, If error messages are in red, then make sure that every error message appears in red in the system. A change to yellow may be interpreted as a change in importance of the message. If common meanings of colors are involved, consistency should be more critical. Inconsistency in color use seriously damages usability of interfaces and character of the application.

3. Simplicity in Navigation

The user's primary form of interaction in interactive multimedia applications is navigating through the contents. Basically, interaction design is really navigation design. In a relatively simple linear structure or a hierarchal structure, it is not a big deal. However, the user can get lost easily in a application that is complex and that contains a large amount of information. The user needs to know where she/he is, what she/he can do there, and how she/he can get out.

According to Brenda Laurell, "Users tend to make heavy use of spatial metaphors: they report feeling "lost," speak of going "up" and "down" between levels or going "in" and "out" of situations. Users often spontaneously construct spatial mental models or mental "maps" in order to move easily from one context to another. This has obvious implications for design. Reducing the memory load on the user is one benefit of making these mental "maps" explicit. Users can refer to the map instead of trying to retrieve memory to tell them "where they are." Another benefit is that a map can form the basis of a mental model on which the user relies to infer how to get from point A to point B without having to keep in mind a set of procedures for navigation. Thus, by exploiting spatial metaphors and allowing the user to make the inference, designers can help users avoid having to ask the question, "How do I get from point A to point B?" [Laurel, 1995 d]

Finally, a good navigation is one that can help users make mental "maps" and

mental models that are intended by designers for a short time. Too much travel and leaps within a document means nothing but confusion which is negative to build mental "maps" and mental models. Also, inconsistency in visual elements, such as headlines, backgrounds, and other key graphics, accelerate the confusion.

As a rule, good navigation design minimizes travel to create the simplest and shortest paths, depth to create a hierarchy with the fewest possible levels because extra levels mean extra travel steps, and redundancy to avoid creating multiple paths to the same place from the same screen to avoid confusion about which to choose. In addition, a good navigation design definitely needs consistency in interface design. As far as navigation design is concerned, the rule, less is better, should be applied.

design process:

developing a prototype

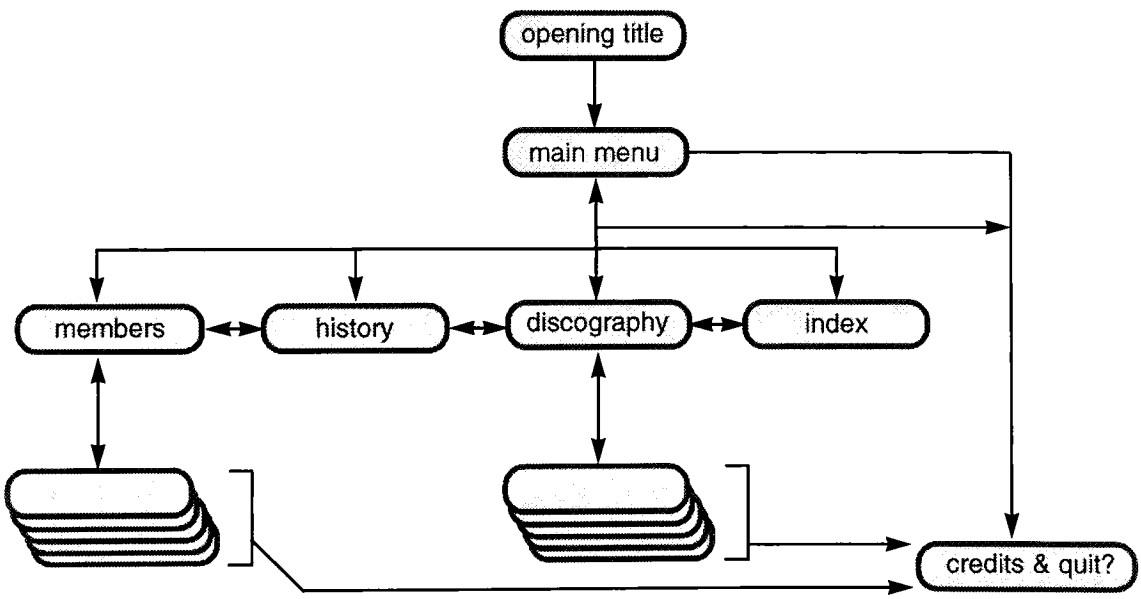
- **overall design concept**
- **navigational structure**
- **interface design and screen design**

overall design concept

As the title indicates, my prototype is about the British progressive rock band, Pink Floyd. The topics dealt in this project are not a lot different from others which concern similar subject matters in the market. However, the project has a quite different design approach. This prototype, entitled "The PINK FLOYD - Interactive Journey Through Time and Space", is an experimental project to look for new ways of interactions which are based on the issues that I considered in the research part. In other words, the priority in the prototype is not developing a well-polished commercial-looking application, but exploring and prospecting new possibilities that GUIs may need in the future. Creating a highly interactive multimedia application which has one identity and one atmosphere through the application is my basic design concept.

navigational structure

The navigational structure of my prototype is quite simple. In order to increase accessibility, depth of levels and width of traveling are minimized. The prototype contains four topic sections, members, history, discography, and index under the main menu screen where users can access every section like mainstream multi-media applications. Only the members section and the history section have lower levels to show more information in detail. Others do not have additional levels. Users can visit any screen by clicking five buttons that appear on all screens in the project. Quitting the application is always available at any screen. The following flowchart shows the navigational structure and the access routes in the prototype.



flowchart of the project

screen design and interaction design

opening sequence

The opening screen starts with a name of a virtual studio, NEW MEDIA LAB, that I imagined. The logo stays on the center of the screen for seconds, then dissolves out. As soon as the logo disappears, a sequence of animated titles, which is created in Adobe After Effects, displays the title and the sub title of the application with a powerful sound effect which is manipulated in MacroMedia SoundEdit 16 after being recorded from a digital keyboard. Before the subtitle disappears replacing its location with a small animation which is a thumbnail of the main screen, there is no interaction between the computer and the user. By clicking the thumbnail the user can enter to the main menu screen.
See figure 1.

main menu screen

Generally, designers spend relatively lots of time creating main menu screens because of the fact that they should contain much more information and controls that take users to the places they want to go. It also must be visually attractive. Dealing with that many things in one small screen effectively is not an easy task. Sometimes, too many things in a main menu makes a user feel confusion and frustration. It even makes the user give up exploring the application. Thus, I avoided putting too many things in the main menu. This screen mainly consists of two visual elements, a 3D rendered image and five buttons below the image which were rendered and animated in Alias/Wavefront, then edited

in Adobe AfterEffects. The five buttons on the bottom of the screen can take a user to five different sections: members, history, discography, index, quit confirmation, and credits. They do not indicate what those buttons are for before a user rolls over one of the buttons. When a user rolls over one of them, it splits into two pieces, showing what the button is for. The 3d image represents the philosophy of Pink Floyd's music, time and space which can be seen often in their themes of music. There are four spinning sand glasses around the sphere-like shape which is suspended in the air surrounded by four water-textured planes. The sand glasses are also buttons that can take the user to the five different sections. See figure 2.

members

On this screen, each of the members' photos is shown in cells of an film strip near the center of the screen. When a user rolls over one of the photos, the cursor disappears, and instead, a green frame appears and tracks the location of the invisible cursor, highlighting the member in the green frame. If the user clicks on the selected photo, the user is taken to the next level screen that displays the profile and biography of the member and four small identical movies which show several different photos of the member. See figure 3.

history

There are three difficulties in dealing with this part. First, the main type of information is not visual, but text, which is not an ideal type of information for interactive multimedia. Second, it is not easy to arrange and display the 30 year-long history of Pink Floyd. Third, the history should show the flow of incidents as well

as independent incidents. The screen should offer a more attractive interface design and interactions to cover the weakness that text has. It also needs a new way of presenting data to avoid users being overwhelmed by too much information at a time. As a result, it requires more interesting interactions and fewer controls in order to compensate for the weakness of this section.
Figure 4 shows how the interface of this section works in details.

discography

Thirty six tiny blue squares appear on the flat, deep-blue typography. The blue squares are buttons that take a user to individual album sections which contain information about the album selected. When the user touches one of the squares, the cover of the album which is assigned to the button comes up from the square, indicating which album section the user is entering. In this section, I intended that the cover of the album appears at the exactly same location on the individual album section as a part of visual element in order to keep visual consistency. By clicking on the cover of the album as well as the discography buttons which appear on every screen with the other four buttons, the user can return to the main discography section. See figure 5.

index

This part is still being developed.

credits & quit

The credits page does not exist independently. When a user clicks on one of the quit buttons which appear on every page, an animated credits text is activated. After that animation, the quit-confirmation button appears. If the user selects "yes", the movie ends. Otherwise, the user is taken to the previous screen.

conclusion

Even if interactive multimedia became one of the mainstream mass media, it is still in the toddler stage. There is no commonly accepted principles about interactive multimedia. In this confusion, nobody can offer an comprehensible explanation what good interface design should be for successful interactive multimedia.

If we, however, assume that pursuing a good interface is for better communication between a user and a computer, it is not so difficult to answer what the good interfaces are. In other words, successful communication between a human and a computer can not be possible without continuous and intensive interactions which can involve the user in that communication because communication is a conversational action. Thus, a well designed interface enhances interactions to a high degree. To achieve the goal, the interface should be delightful. What makes interactions delightful? The question is quite simple. If an application offers surprise, confirmation of expectations, and aesthetic stimulation via intuitive, transparent, and predictable interfaces and interactions, the user will enjoy communication with a computer or an application.

appendix

- figures
- bibliography

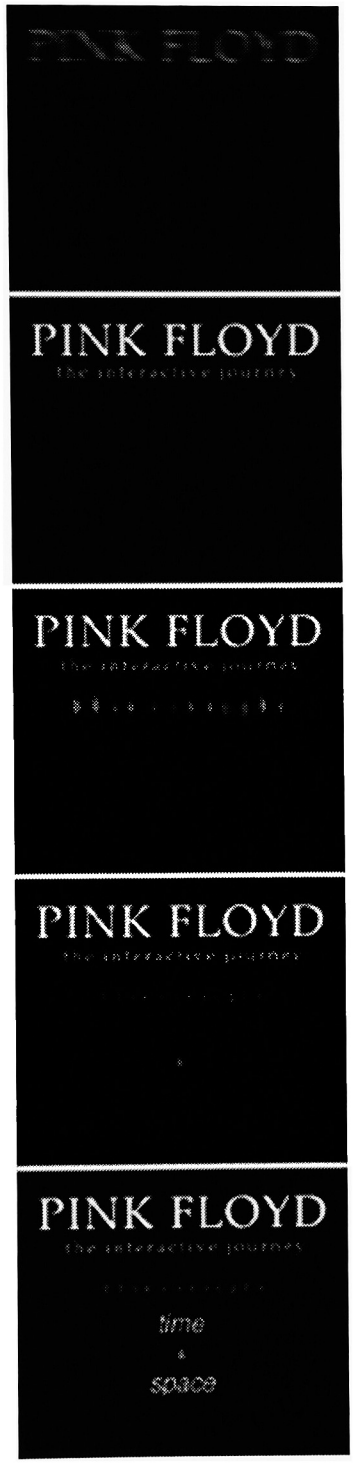


Figure 1

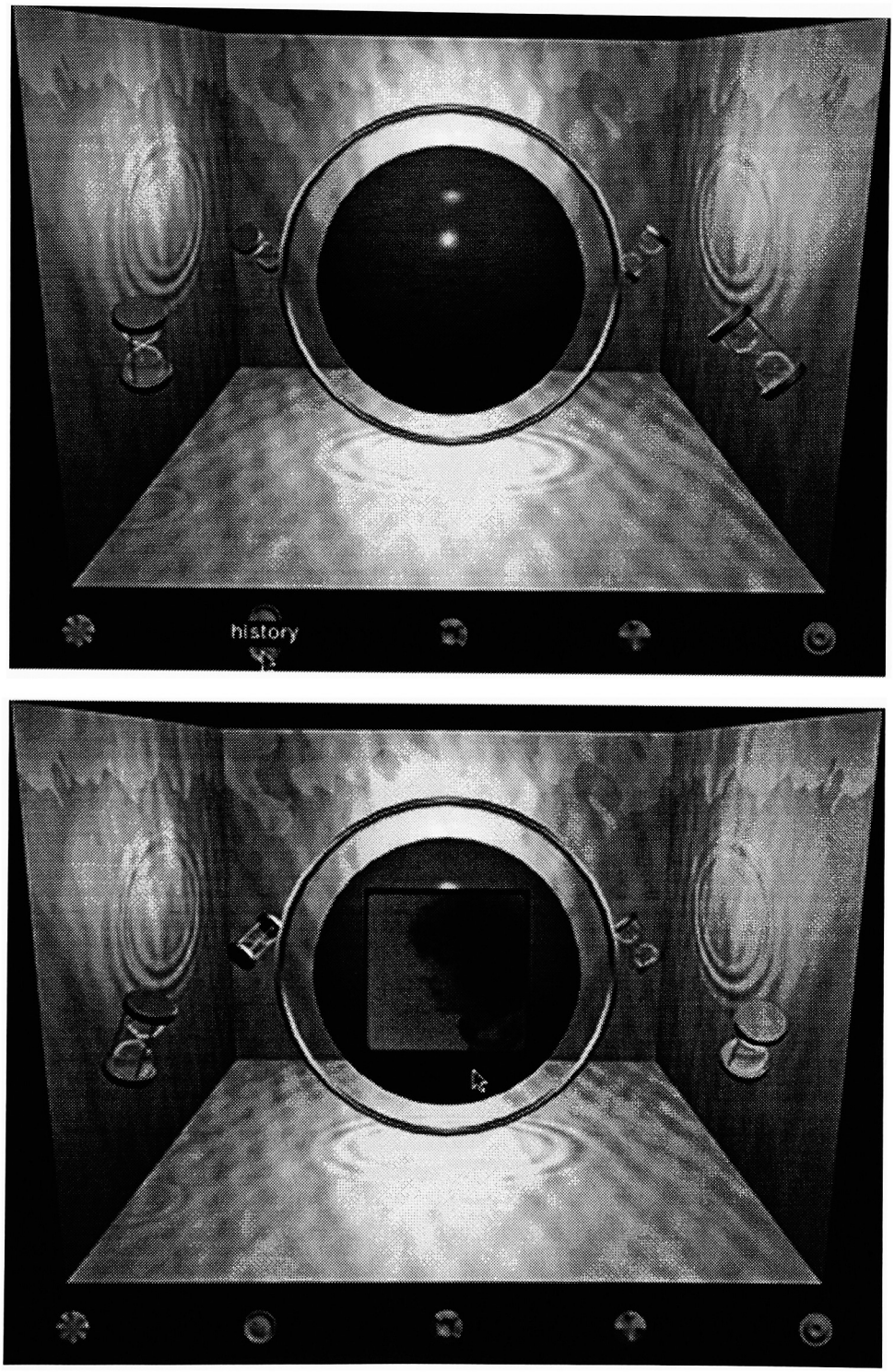


Figure 2

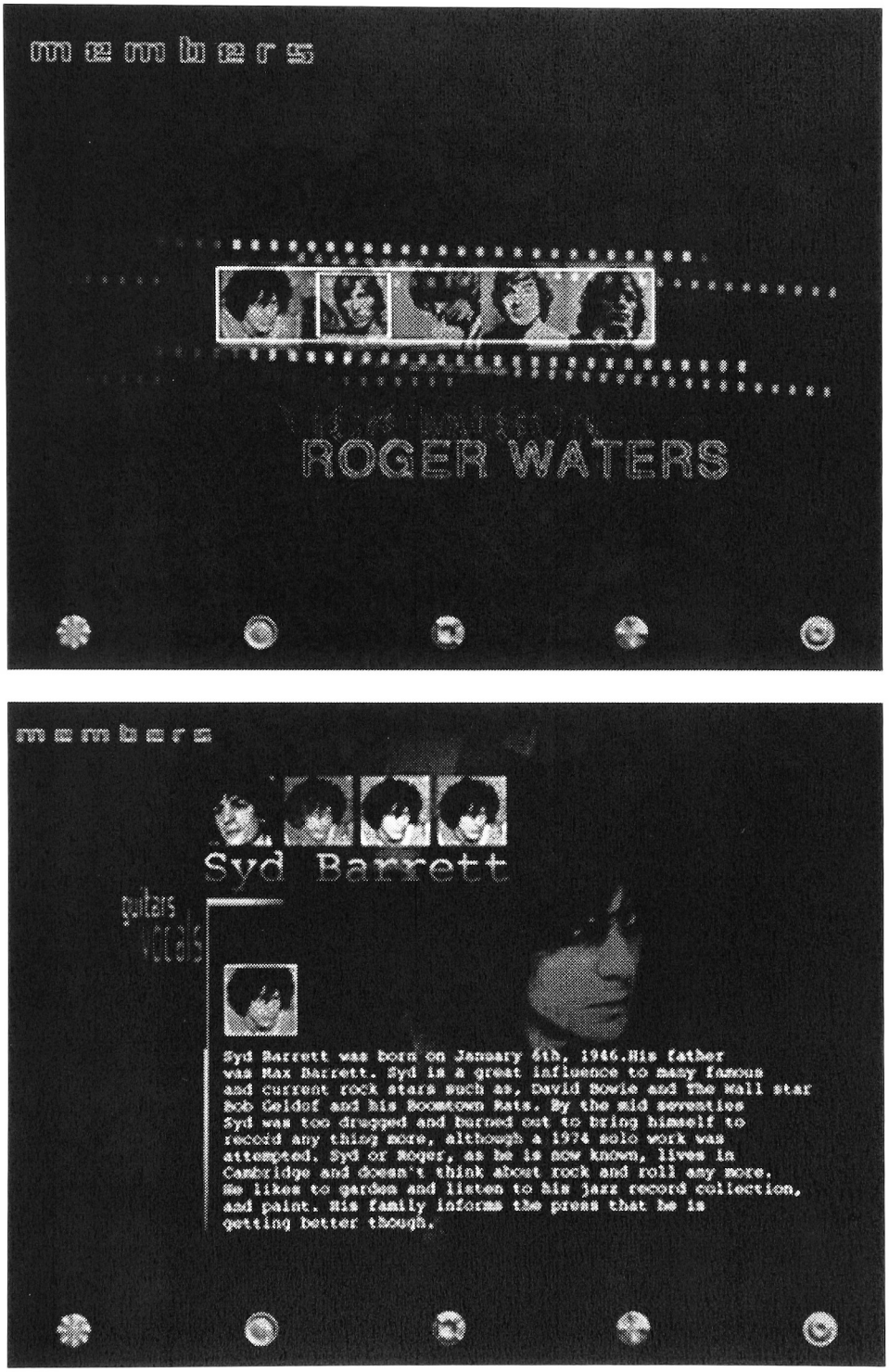

members
ROGER WATERS
members
Syd Barrett
guitars
vocals
Syd Barrett was born on January 6th, 1946.His father
was Max Barrett. Syd is a great influence to many famous
and current rock stars such as, David Bowie and The Wall star
Bob Geldof and his Boomtown Rats. By the mid seventies
Syd was too dragged and burned out to bring himself to
record any thing more, although a 1974 solo work was
attempted. Syd or Roger, as he is now known, lives in
Cambridge and doesn't think about rock and roll any more.
He likes to garden and listen to his jazz record collection,
and paint. His family informs the press that he is
getting better though.

Figure 3

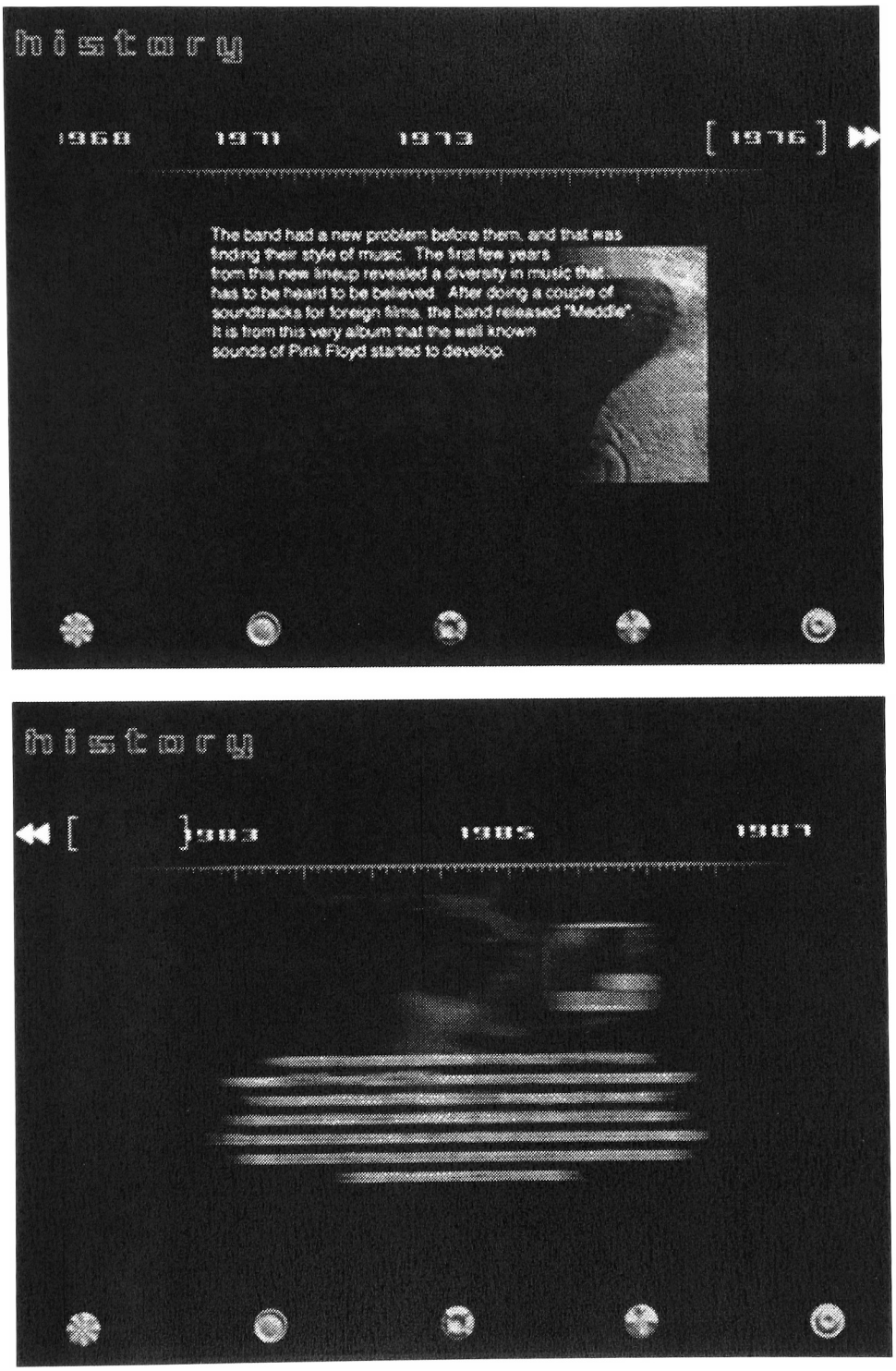

history
1968
1971
1973
[1976]
The band had a new problem before them, and that was finding their style of music. The first few years from this new lineup revealed a diversity in music that has to be heard to be believed. After doing a couple of soundtracks for foreign films, the band released "Meddle". It is from this very album that the well known sounds of Pink Floyd started to develop.
history
[ ]1983
1985
1987

Figure 4


discography
discography
A SOURCERFUL OF SECRETS
produced by Norman Smith
1968
members
David Gilmour
Roger Waters
Richard Wright
Nick Mason
tracks
Let There Be More Light
Remember A Day
Set The Controls For The Heart Of The Sun
Corporal Clegg
A Saucerful Of Secrets
See-Saw
Jugband Blues

Figure 5

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